

THE
ONTARIO WATER RESOURCES
COMMISSION

BIOLOGICAL SURVEY

of the

ABITIBI RIVER

STANDARDS DEVELOPMENT BRANCH OMOE
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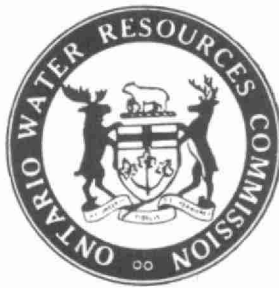
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Biological survey of the Abitibi
River, 1967 / German, M.J.

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1967

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December, 1968

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SUMMARY

The Abitibi Power and Paper Company Limited located at Iroquois Falls is the major source of wastes being discharged to the Abitibi River.

Findings of this survey have shown that pulp mill wastes present in the system are excessively damaging to indigenous aquatic communities. Specifically, the distribution and abundance of bottom dwelling organisms indicated that the river was heavily polluted for a distance of 37 miles below the mill site and recovery was incomplete at the 50 mile range.

In addition, widely fluctuating water levels related to the controlled discharge of water at Iroquois Falls and excessive natural and induced siltation further compound the pollution problem in the river.

Owing to these polluttional and flow regime factors, water quality and the related aesthetic conditions of the Abitibi River are unsatisfactory for supporting multiple water uses, and in particular those which pertain to river bank development as set forth in the Glackmeyer Report on Multiple Land Use Planning for the Cochrane Clay Belt.

RECOMMENDATIONS

To provide abatement of pollution and restoration of the multiple use potential of the Abitibi River, it is recommended that:

1. Suspended solids losses from the Abitibi Power and Paper Company Limited be reduced to meet the Commission's objective.

2. Waste loadings should be reduced and river flow stabilized to ensure the maintenance of 5 ppm dissolved oxygen in the river in order to support healthy game and commercial fish populations.

3. The silt burden of the river be reduced by the implementation of optimum control on soil erosion resulting from logging practices.

BIOLOGICAL SURVEY OF THE ABITIBI RIVER

INTRODUCTION

A biological survey of the Abitibi River above and below Iroquois Falls was carried out during June, 1967 to provide an evaluation of water quality.

The nature and degree of pollution produce variable effects on aquatic life, altering the normal population structure or community balance that is characteristic of clean water situations.

Animals living in or on the river bottom (bottom fauna) are valuable food organisms forming a vital link in the food chain of fish. Because of their extended life cycle, lack of mobility and the varying abilities of different forms to survive water quality changes, these organisms provide a reliable indication of water quality changes at the sampling site over a period of several months prior to sampling. Furthermore, the degree of alteration of the bottom fauna reflects the degree of related changes in higher trophic levels, especially fish.

Description of study area

The Abitibi River originating at Lake Abitibi flows northward as a tributary of the larger Moose River flowing to James Bay. There is little or no flood plain throughout the examined portion of the river and the mean

width is approximately 100 yards. Flow through the study area is controlled by the Abitibi Power and Paper Company Limited at Iroquois Falls. The mean flow for the Abitibi River at Iroquois Falls is 6,270 c.f.s. During the present investigation, provisional records indicate that discharges at Iroquois Falls varied from a maximum of 88,880 c.f.s. on June 24th to a minimum of 800 c.f.s. the following day.

WATER USES

Transportation of pulplogs

The Abitibi River upstream from Iroquois Falls is utilized by the pulp mill for transportation and storage of pulplogs from the cutting grounds to the mill site.

Hydro-electric power

The Abitibi Power and Paper Company Limited owns and operates three hydro-electric power developments situated at Twin Falls, Iroquois Falls and Island Falls and a fourth generating station at Abitibi Canyon is operated by the Hydro-Electric Power Commission of Ontario.

Water supply

The Abitibi Power and Paper Company Limited owns and operates the water works providing domestic water for the mill, the Town of Iroquois Falls, and the communities of Ansonville and Montrock in the Township of Calvert. The source of supply is the Abitibi River and water for domestic use is treated by the company prior to distribution to the estimated 6,000 people served by this water supply system. Water for mill processing purposes is pumped from the Abitibi River by the company at an estimated rate of 24 million gallons per day.

Wildlife and recreation

At the present time, the Abitibi River is utilized sparingly for hunting, fishing and trapping activities. There is an active commercial fishery for sturgeon and some boating occurs on the lower reaches of the study area. Future land use plans have made provision for development of the river shoreline as a recreational resource. As part of a comprehensive land use study, the Glackmayer Report of Multiple Land-Use Planning for the Cochrane Clay Belt, made recommendations which would reserve a buffer zone from the river edge for primary recreational use including cottage sites, parkettes, wildlife preserves and related water uses.

Disposal of wastes

The main source of wastes entering the river originates from the Abitibi Power and Paper Company Limited which produces 925 tons of newsprint per day using approximately 75% groundwood and 25% sulphite pulp and an additional 50 tons per day of wrapper paper is produced. Mill wastes amounting to approximately 24 million gallons per day are discharged to the river without treatment except for some solids removal. A bark recovery and disposal unit was being installed while the present field investigations were in progress.

Sanitary wastes from the Town of Iroquois Falls (population 1,745) and the community of Ansonville-Montrock (population 4,205) are collected in sanitary sewers for discharge without treatment to the Abitibi River.

In addition to direct discharge of wastes, further contamination of river water results from silt loading. The river source, Lake Abitibi is a shallow, clay-bottom body of water subject to considerable wave action and re-suspension of bottom sediments. Water discharged from the lake is

highly turbid, containing considerable particulate matter. Forest development has involved considerable soil disturbance which undoubtedly imposes an additional silt burden in the river. Scars on the landscape made by access roads and the areas disturbed by timber harvest especially skidtrails, provide vertical paths for erosion from the denuded slopes. Compounding the silt burden carried by the river due to the above mentioned sources, the steep river banks of clay are highly prone to landslides during periods of high flow in which large quantities of clay are dislodged to the river.

Pollutional effects of pulp mill wastes

Adequate dissolved oxygen levels are essential to sustain fish and other aquatic life. For fish, dissolved oxygen requirements must satisfactorily provide for egg development, for the newly hatched young and for normal growth and development through the later life stages. Field studies have shown that good and diversified warm water fish populations can occur in water in which the dissolved oxygen level is between 5 and 6 mg/l during the summer months. If the dissolved oxygen is never less than 5 mg/l, healthy fish populations will be assured.

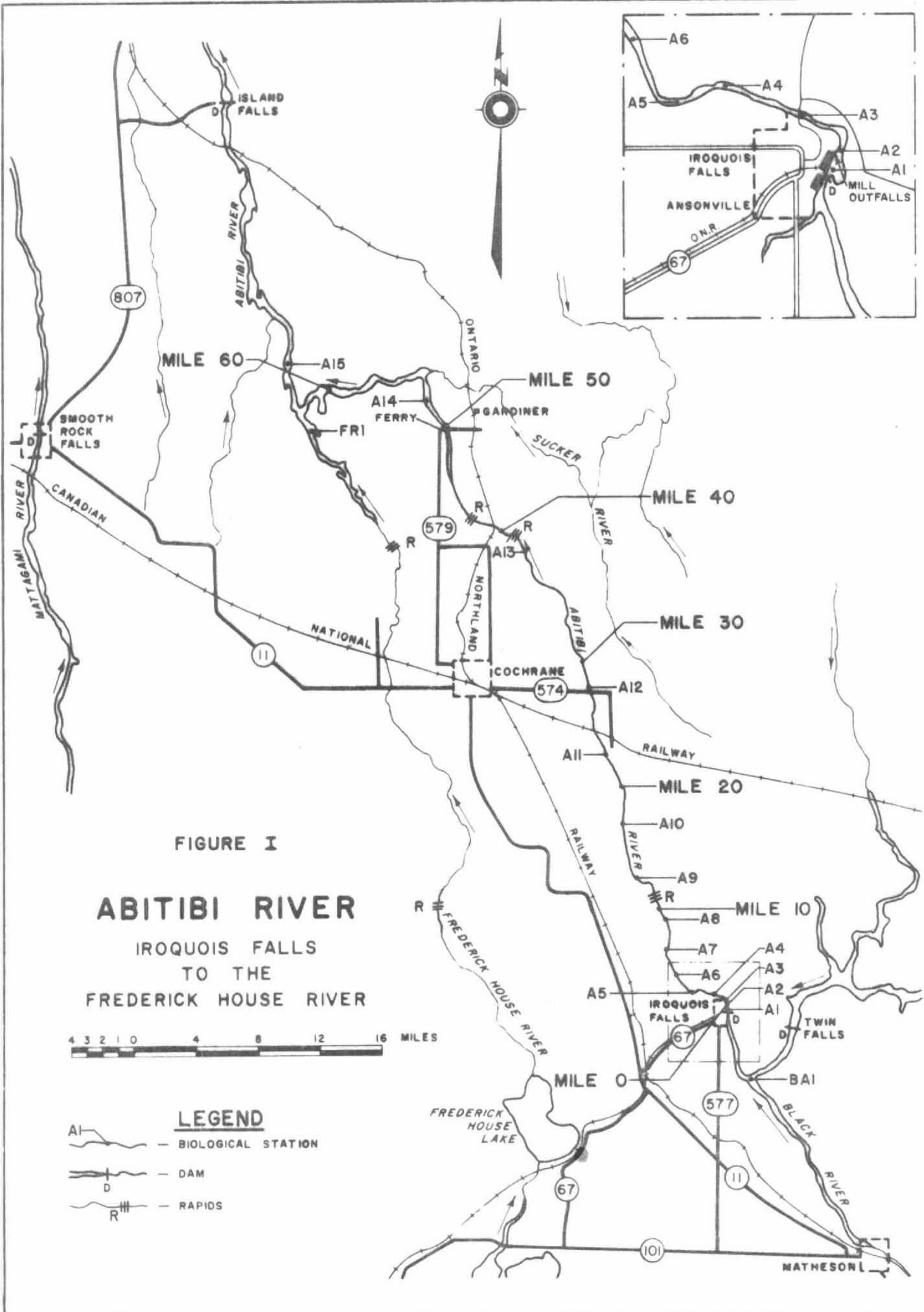
Inputs of fibre and other organic wastes have an oxygen-depleting effect on the receiving water owing to the bacterial demand for dissolved oxygen associated with organic decomposition. Bark and fibre wastes are a significant component of the ultimate Biochemical Oxygen Demand (BOD) of pulp mill wastes. However, these elements are oxidized very slowly and their oxygen demand cannot be determined in a laboratory five-day BOD test; nonetheless, they exert a significant residual influence on the quality of the receiving water. Oxidation of these wastes at the sludge-water interface may

reduce dissolved oxygen to toxic concentrations, as well as releasing toxic levels of decomposition by-products such as hydrogen sulphide (Colby and Smith, 1967). Studies carried out by Stein and Denison (1966) on the in situ benthal oxygen demand of cellulosic fibres determined that sludge deposits from a sulphite pulp mill utilize $3.60 \text{ g O}_2/\text{day/m}^2$. In addition to demands on the oxygen resource, blanketing of the river bottom with these wastes destroys natural fish spawning beds and interferes with production of fish food organisms. The resultant substrate is unstable and damaging to bottom fauna which possess delicate appendages (i.e. mayflies, caddisflies and alderflies). Forms of simpler morphology (i.e. clams, snails, leeches, midge larvae and sludgeworms) may be able to withstand physical abrasion, however, these forms are selectively eliminated in order of their intolerance to water quality changes.

A series of experiments by Smith et al. (1963, 1965, 1966 and 1967) have been carried out to determine some lethal and sub-lethal effects of pulp mill wastes on fish life. These studies have demonstrated that sulphite and groundwood wastes decrease the hatchability of fish eggs and survival of fish fry as well as affecting a number of sub-lethal physiological changes in mature fish, all of which result in poor fish production.

METHODS

Biological investigations on the Abitibi River were carried out in June, 1967. Sampling ranges are illustrated in Figure I. Field sampling procedures were employed as outlined hereafter.



Floating bark

The quantity of bark floating at the river surface was sampled across several transects downstream from the mill. The river was traversed four times at each range hauling a circular retaining net with a mouth opening of 18 inches. Constant towing speed was maintained and all transects except A1 were selected to have comparable physical features. Bark samples were air-dried and returned to the laboratory for dry weight determinations.

Bottom sediments

A ponar dredge was employed to secure samples of the river sediment. Each dredge sample received gross examination in the field and the components were classified in order of relative abundance. Samples were then sifted through a 24-mesh-per-inch box-screen and all matter retained by the screen was returned to the laboratory for further classification of the organic components.

Bottom fauna

Five samples of the bottom fauna were secured at equally spaced stations along each of sixteen transects on the Abitibi River and one transect of the Fredrickhouse River. Samples of the sediment were screened as described above and macroinvertebrates retained by the box screen were sorted into vials of 95% alcohol, returned to the laboratory and microscopically identified and enumerated.

SURVEY FINDINGS

Floating pulp wastes

Downstream as far as the confluence of the Abitibi River with the Fredrickhouse River, bottom sediments were

blanketed by bark and fibre. Large islands of pulp wastes had built-up between ranges A2 and A3 and similar islands surrounded the mill outlet. In June, huge quantities of bark were noted floating at the surface as far downstream as the ferry crossing at Highway 579. Attempts were made at several ranges to estimate the bark load carried at the surface, by means of the 18-inch diatemer net. The river velocity at the time of these collections was estimated to be between four and six miles per hour. The estimated tonnage per day of floating bark was calculated assuming a conservative flow of four miles per hour. These values appear in Table 1.

It should be noted that the values in Table 1 are representative of the high water period of flow and consider only floating bark, of which a portion would be derived from re-suspension of old deposits. No attempt was made to estimate the portion of bark being translocated below the water surface.

Table 1. Calculated tonnage of floating bark (at surface) at seven locations on the Abitibi River in June, 1967. Sampling methods are outlined in text of the report.

Transect	Date Sampled	Distance in miles from pulp mill	Calculated dry weight in tons/day
A1	June 17	-1/8	.29
A3	June 17	1	260.3
A5	June 17	3	169.1
A8	June 17	8	125.3
A9	June 23	12	128.6
A12	June 23	24	85.8
A13	June 20	34	1.13

As the calculations for transect A1 suggest, it is probable that less than one ton per day represents a fairly accurate estimate of the bark loading derived from the booming operations above the mill. In contrast to this low level, the estimated quantity of bark passing the railway tressel below the mill (Transect A3) was calculated to be 260 tons per day. Bark passing that location may be trapped in back-eddies but is eventually deposited to the river bottom.

Values on transects further downstream indicate that two-thirds of these wastes are deposited within 24 miles of the mill (Transect A12) and nearly 100 per cent settles before reaching the 34-mile transect at A13.

Bottom deposits

Natural sediments of the river bottom varied from loamy silt to coarse sand. Mixed with these soils and overlying them were bark and fibre fragments. Table 1 of Appendix indicates the distribution of pulp wastes (bark and fibre) at each of the sample sites. Generally areas covered by fibre as contrasted to bark were distinct, varying from station to station along each transect.

The river upstream from Iroquois Falls is utilized to float logs to the mill. Bark sloughed from these logs was present but not abundant at the control station BA1, one mile upstream from the mill. Some form of pulp wastes were present at each transect examined between Iroquois Falls and the junction of the Abitibi with the Fredrickhouse, a distance of approximately 45 miles. These wastes were not present in the sediments of the Fredrickhouse River or on the river bottom downstream from the confluence of this river with the Abitibi.

BIOLOGICAL ASSESSMENT OF WATER QUALITY

Total numbers of organisms secured from five replicate samples at each sampling range appear in Table 2 of the Appendix.

Bottom fauna at the control station BA1 upstream from the pulp mill contained an assemblage of seven major taxa including pollution-intolerant mayflies, caddisflies and alderflies. Pollution-tolerant and facultative forms were also present, but in low densities normal in unpolluted waters. Downstream from the pulp mill, a few pollution-intolerant mayflies and caddisflies were secured through a distance of two miles, probably as a result of drift from the unpolluted upstream waters. Throughout the following thirty-seven miles, a total of fifty sediment samples were secured (Transects A4 to A14) and examined without success for these pollution-intolerant organisms. Forms having moderate tolerance to pollution (i.e. snails, clams and leeches) were absent for six miles below the mill. These forms became re-established at Transect A7. At the same time, pollution-tolerant sludge-worms increased in density below the mill discharge and maintained a substantial density as far downstream as the confluence of the Fredrickhouse with the Abitibi. Following dilution from the Fredrickhouse, benthic communities at Transect A16 were improved but could not be considered normal in comparison to the Fredrickhouse control station F1.

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APPENDIX

Table I Classification of the substrate at
 bottom fauna sampling locations on
 the Abitibi River in June, 1967.

Table II Occurrence of major taxonomic groups
 of bottom fauna at sixteen locations
 on the Abitibi River and control
 stations FRI on the Fredrickhouse
 River in June, 1967.

Table 1. Classification of the substrate at bottom fauna sampling locations on the Abitibi River in June, 1967.

	West	West Centre	Centre	East Centre	East
BA	Loam Bark	Sand Bark	Sand Bark	Sand Bark	
A1	Sand Bark	Sand	Clay Bark	Clay	Clay
A2	Clay Bark	Sand Bark Fibre	Sand Bark Fibre	Sand Bark	Fibre
A3	Clay Fibre Bark	Fibre	Bark	Fibre	Clay Fibre
A4	Clay Fibre	Clay Fibre	Bark	Bark	Fibre Bark
A5	Bark	Bark	Bark	Loam Bark	Loam Fibre Bark
A6	Clay	Fibre	Bark Fibre	Bark Fibre	Bark Fibre
A7	Loam Fibre	Clay Fibre	Bark Fibre	Bark Fibre	Loam Fibre
A8	Loam Fibre	Clay Fibre	Bark	Clay Fibre	Clay Fibre
A9	Sand Fibre Bark	Sand Fibre Bark	Sand Bark	Sand Fibre	Sand Fibre Bark
A10	Sand Fibre	Sand Fibre	Bark	Sand Bark	Sand Fibre
A11	Sand Fibre	Clay	Sand Bark	Bark	Sand Fibre
A12	Clay Fibre	Clay Fibre	Sand	Sand Fibre	Clay Fibre
A13	Sand Fibre	Sand Fibre	Sand	Bark	Sand Fibre
A14	Clay Fibre	Bark	Clay Bark	Clay Fibre	Clay Fibre
A15	Clay	Clay	Clay	Clay	Clay
FR1	Clay	Clay	Clay	Clay	Clay

Table II. Occurrence of major taxonomic groups of bottom fauna at sixteen locations on the Abitibi River and control station FR1 on the Fredrickhouse River in June, 1967.

Station	BA1	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	FR1
Distance (miles)	-1	-1/8	1/4	1	2	3	4	6	8	12	16	20	24	34	39	50	-50
Depth (feet)	25	12	16	15	17	20	22	26	24	24	22	23	25	18	26	35	30
Mayfly	4	2	2		1											1	6
Caddisfly	1		1		1										3		9
Alderfly	1															1	
Diptera	7	24	184	145	32	14	2	54	65	146	136	110	346	4	15	52	10
Amphipod			2														
Clam	45	7	1	6					5	37	7	52	79	1	62	143	18
Snail											2	5	4	1			
Leech	4							3	3	5	4	15	12	4	20	4	
Worm	20	127	362	1935	221	1418	617	619	372	548	1570	7510	1473	822	6881	373	93